Revolutionizing Plant Phenotyping

plantDitech

About us

- Developed at HUJI
- Commercial since 2017
- Over 70 scientific articles
- Distinguished customers:

WAGENINGEN UNIVERSITY & RESEARCH

Hochschule Geisenheim University

JKI Julius Kühn-Institute Federal Research Centre for Cultivated Plants

UC Davis

Embrapa

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

UF IFAS UNIVERSITY of FLORIDA

CREA

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Haifa

CABBI CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

CNR

ProFarm

SEA6 ENERGY

DONALD DANFORTH PLANT SCIENCE CENTER

MARS WRIGLEY

Ministry of Agriculture & Rural Development

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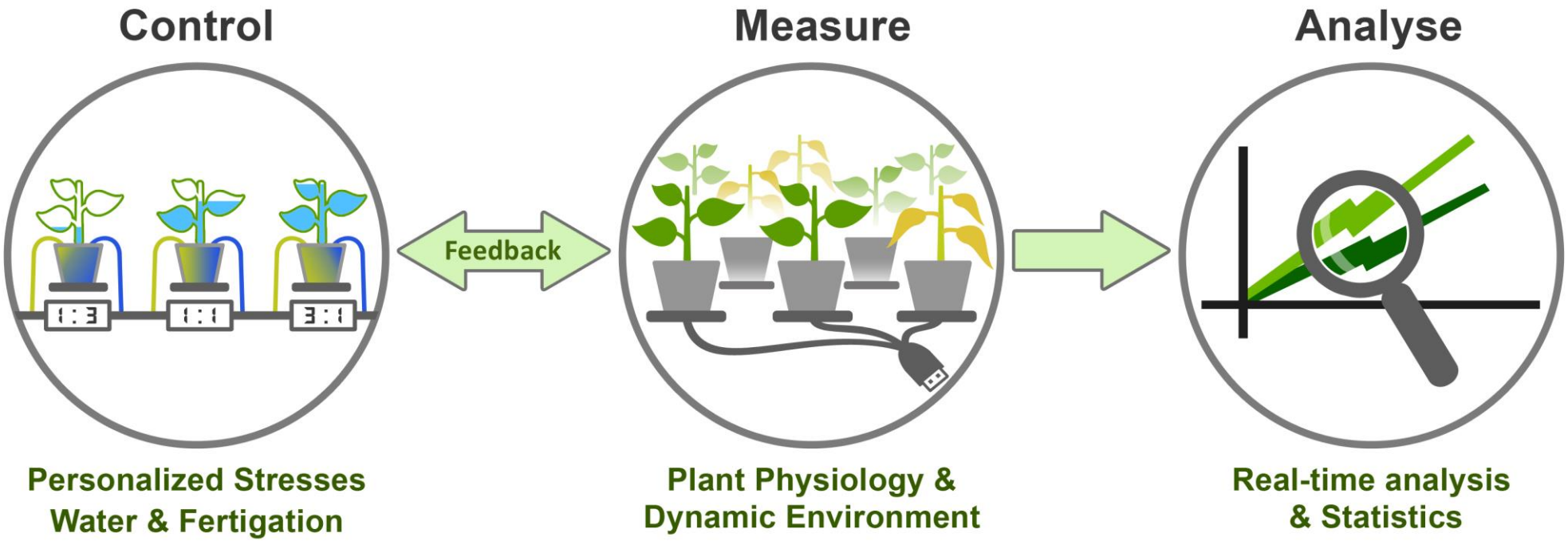
PlantArray Platform



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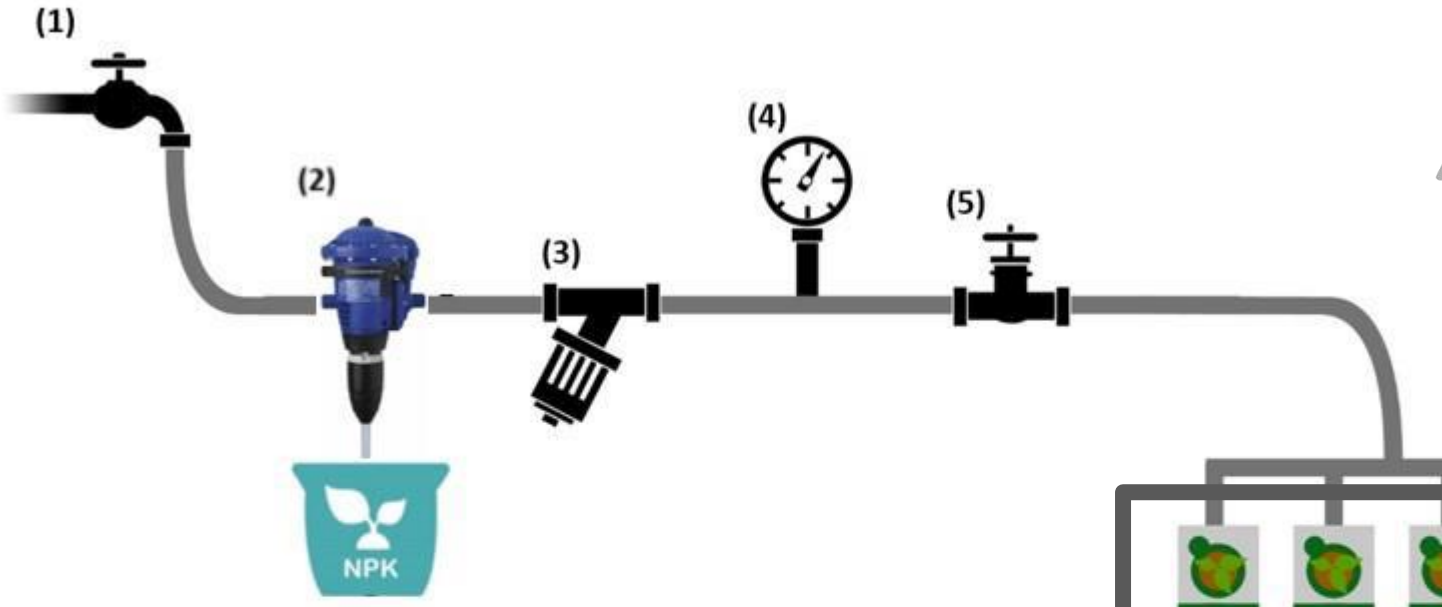
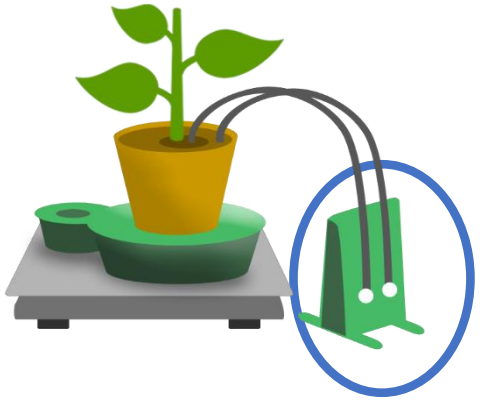
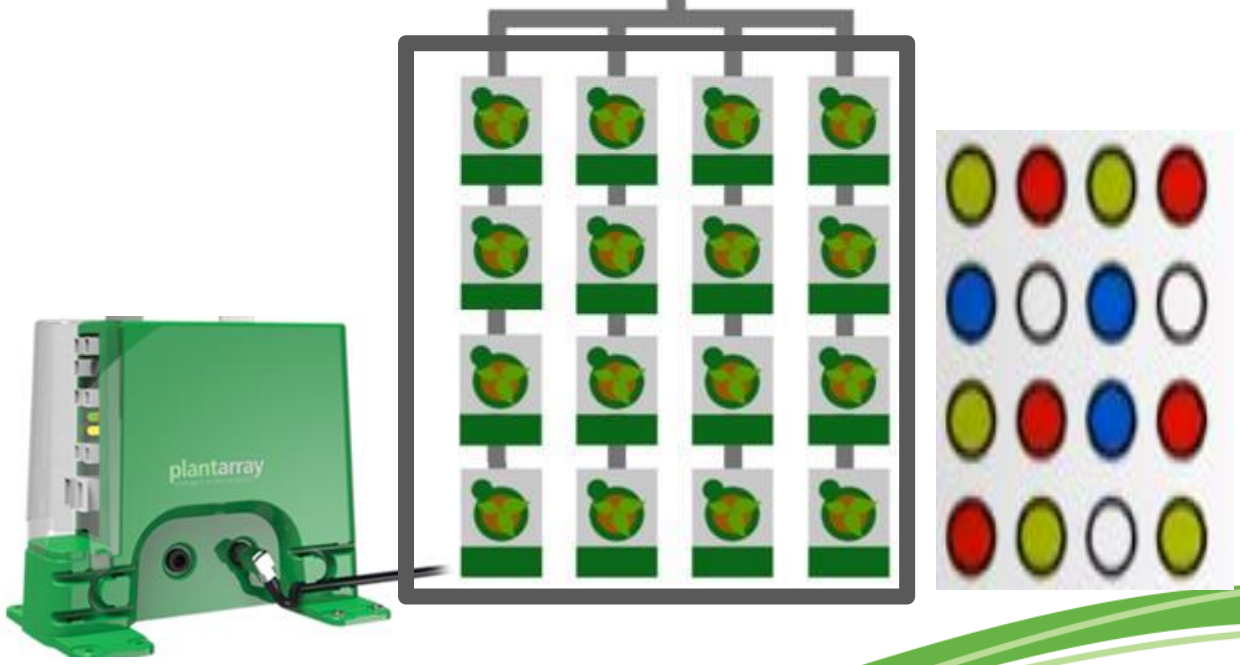
Personalized irrigation – advantages:





- ✓Simultaneous instant irrigation
- ✓Randomization
- ✓Feedback treatment per plant
- ✓Low risk for system downtime



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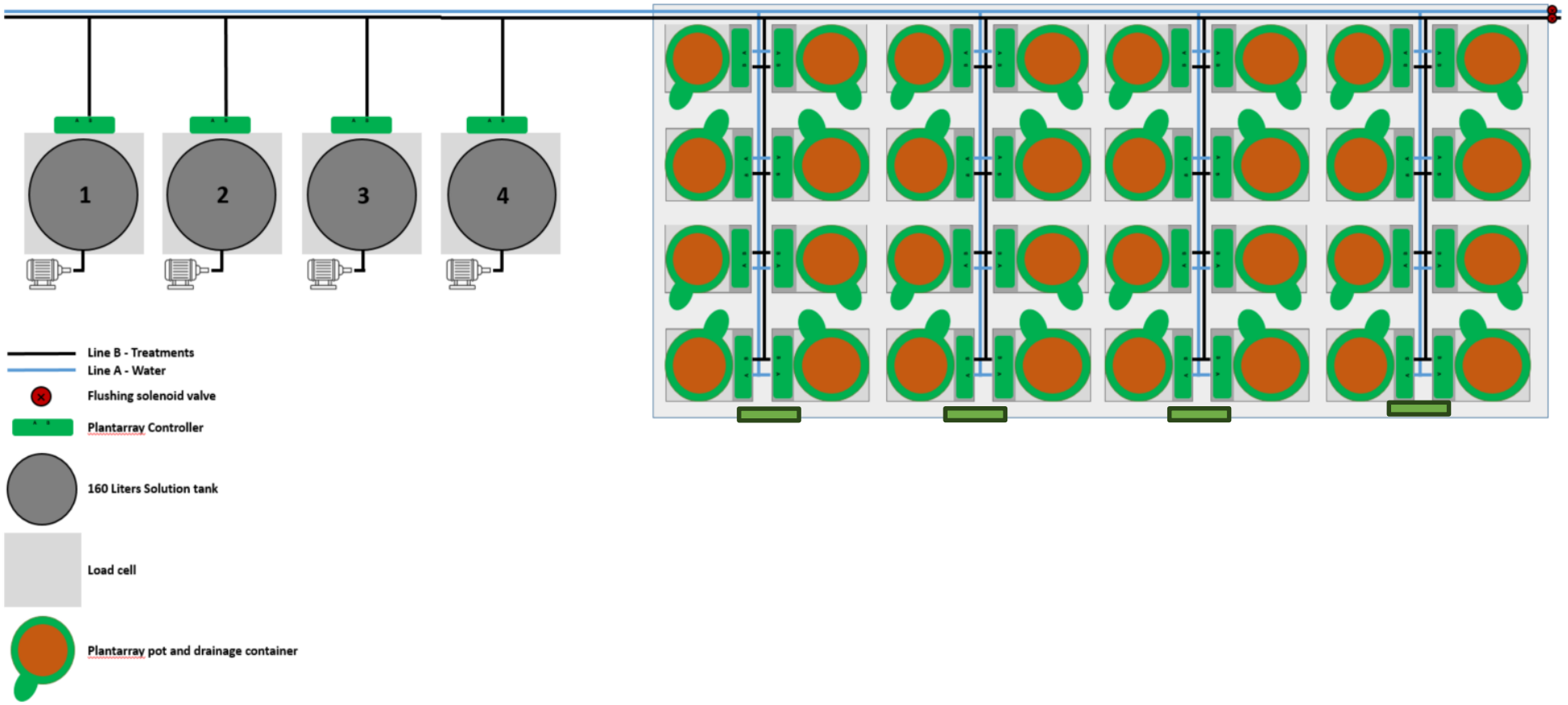
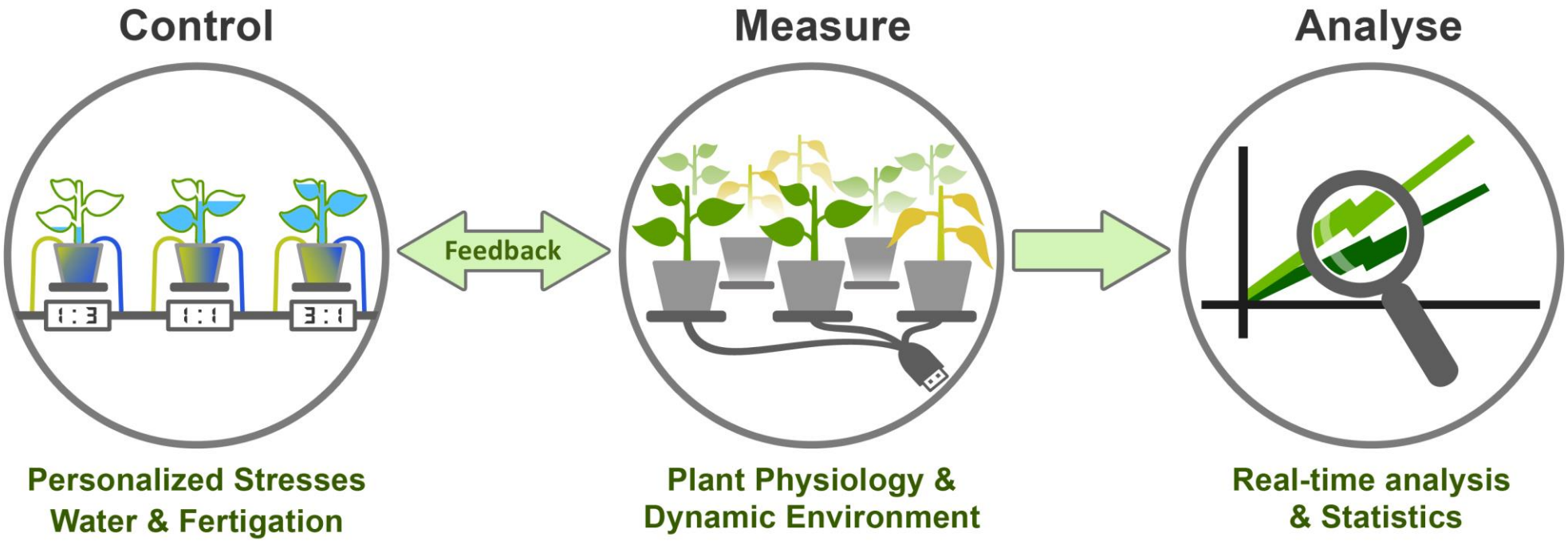
MultiFerti


1
2
3
4
Line B - Treatments
Line A - Water
Flushing solenoid valve
Plantarray Controller
160 Liters Solution tank
Load cell
Plantarray pot and drainage container

PlantArray Platform



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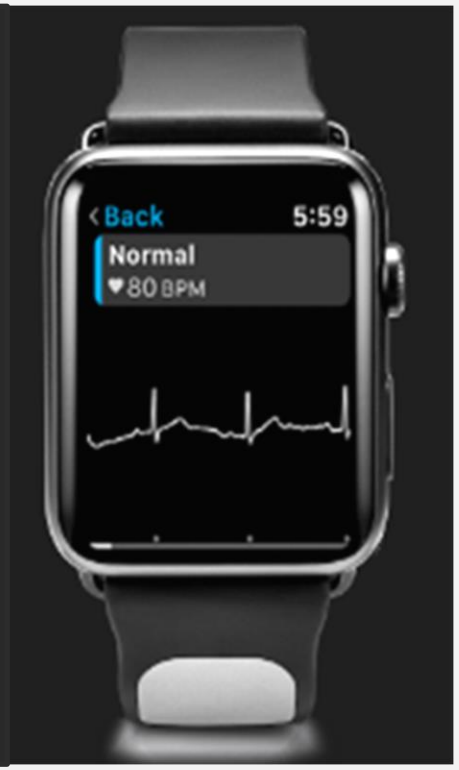
Manual physiology phenotyping

Source: LICOR

- Slow
- Heavy workload
- Plant-by-Plant
- On a leaf level
- Not comparable
- No irrigation control

Plant performance based on dynamic Physiology



+ Automated
+ Dynamic
+ Simultaneous
+ Whole plant
+ Irrigation

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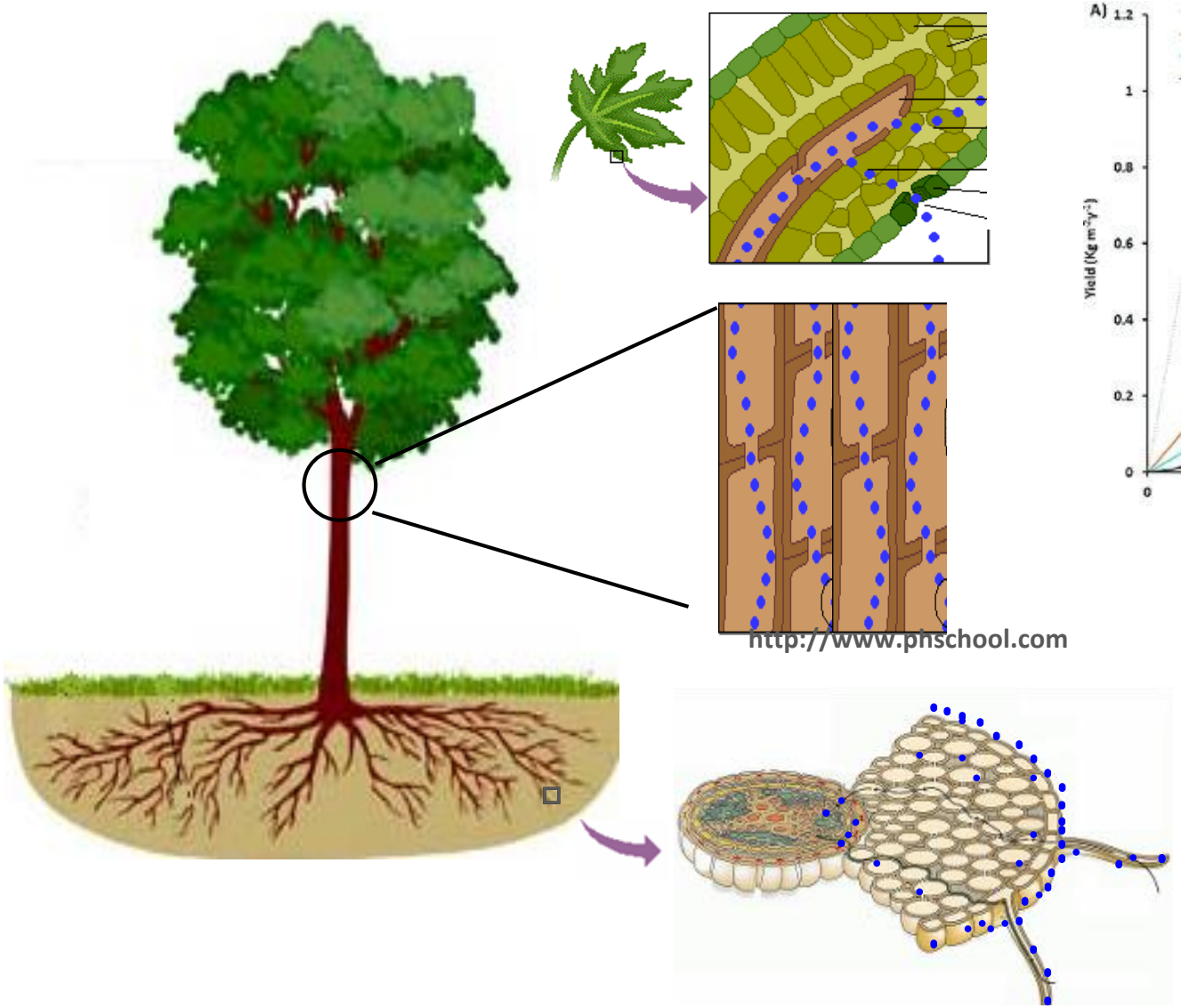
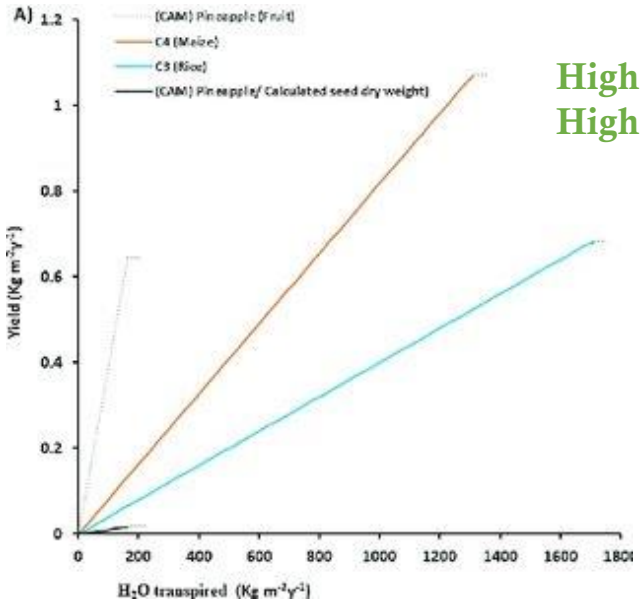
Plant-water activity defines yield potential





High Transpiration
High Yield

High Stomata activity
High Yield

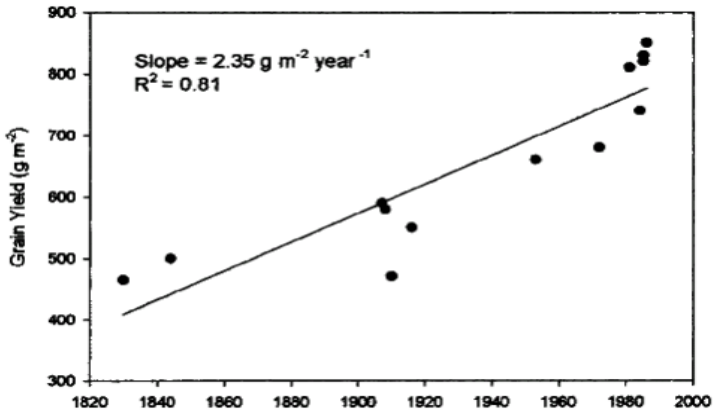
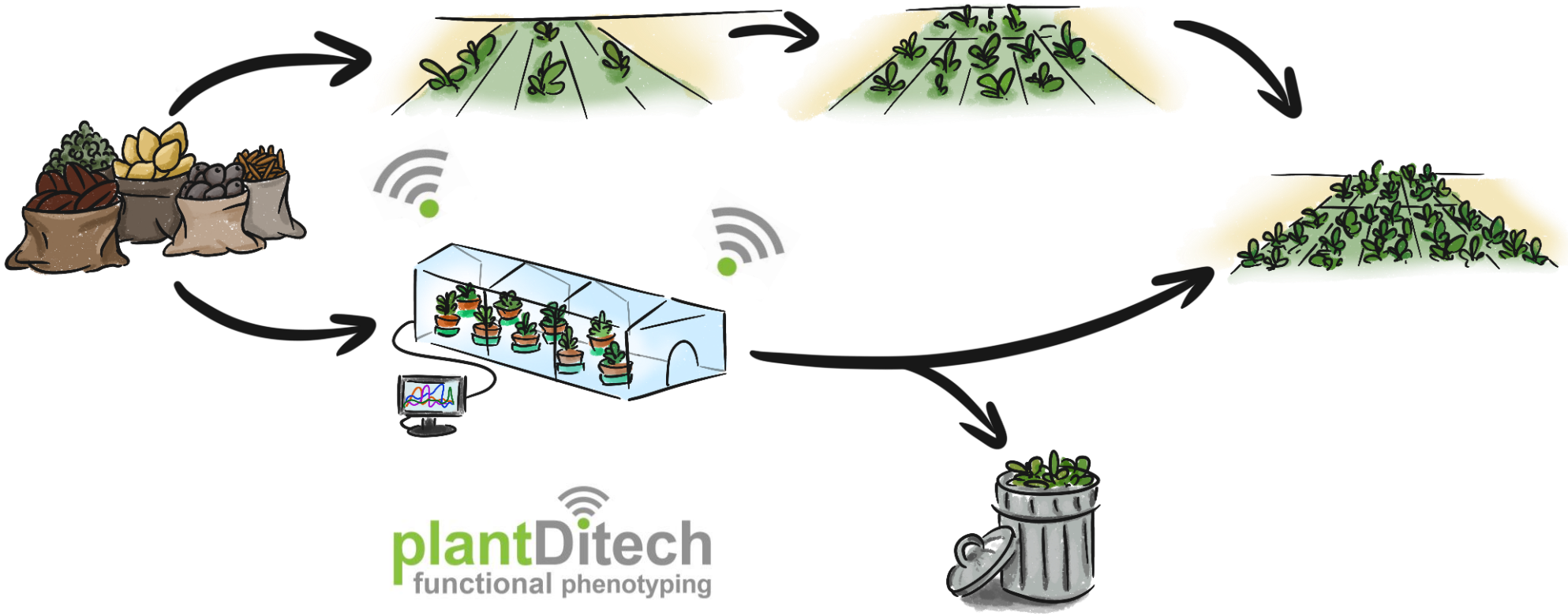


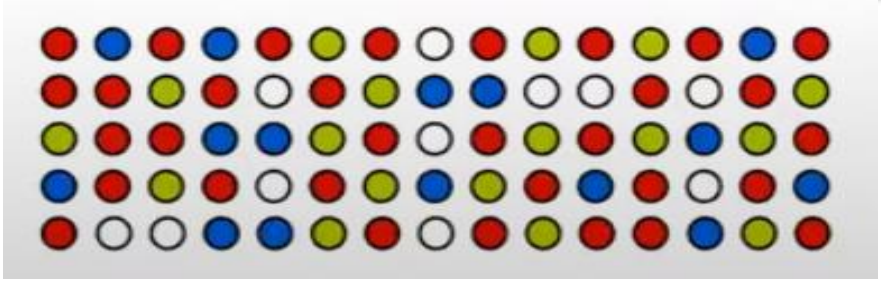
Fig. 1. The relation between grain yield, and year of release of wheat cultivars released in the UK since 1820. (Data adapted from Austin *et al.*, 1989.)

Increase Ag – Research Efficiencies

Deep insight into the **Plant**-**Water**-Balance
Significant time savings- days instead of full seasons



PlantArray Technology



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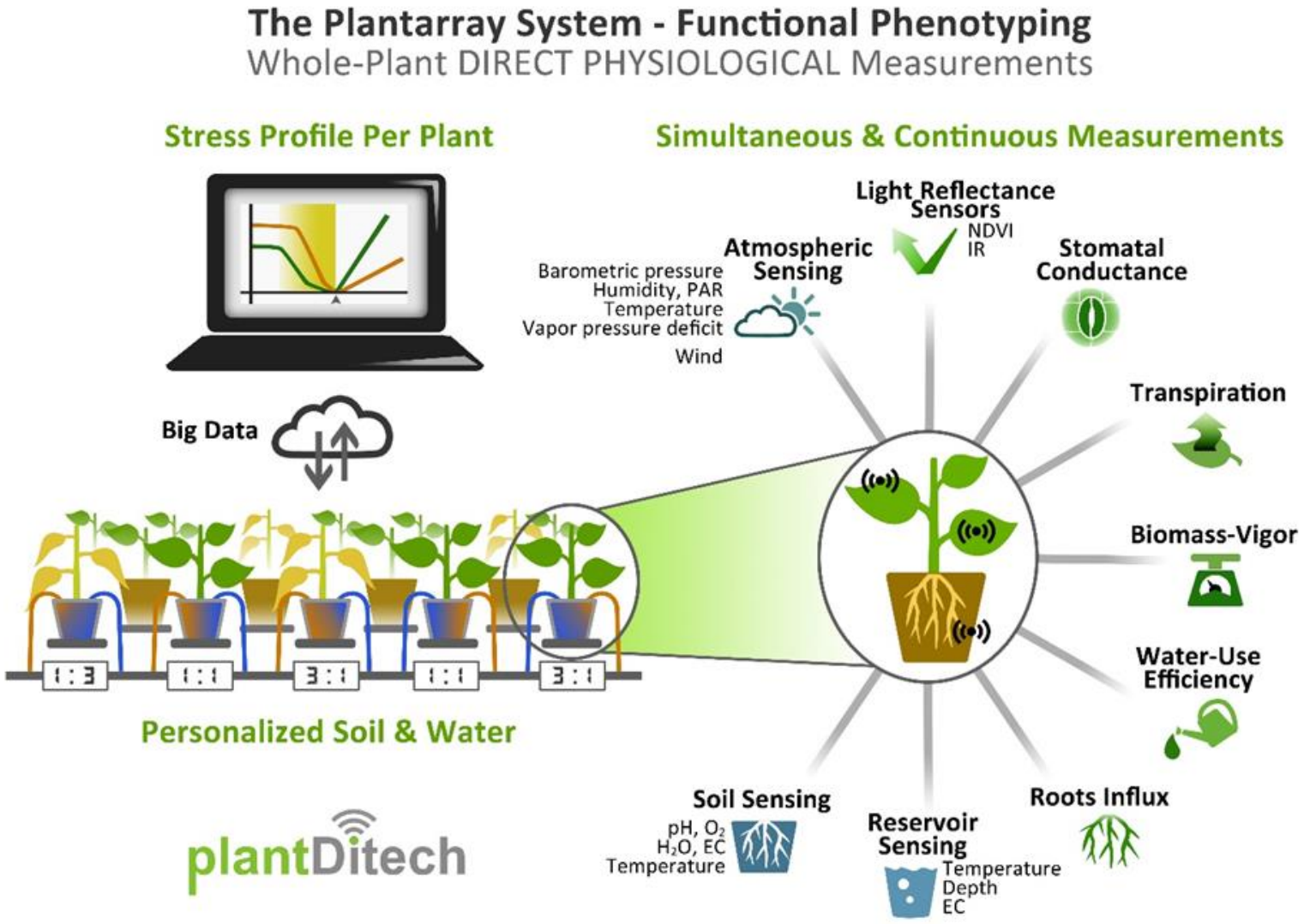
PlantArray Platform



Hardware:

Control + Analytical software:

For a large variety of plants and growth stages

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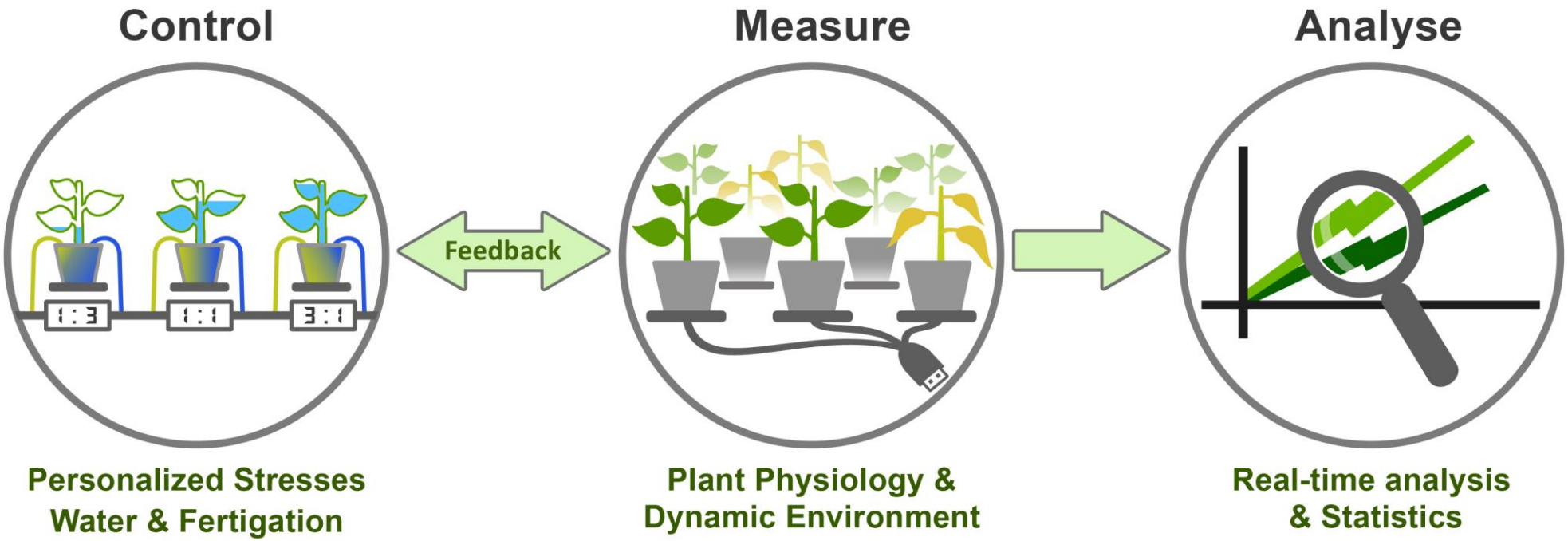
Radicle Crops acquires Wageningen quinoa breeding program

Since 2019, RC and WUR have been collaborating in quinoa genetics and breeding research, leading to major breakthroughs, including the development of a F1 Hybrid breeding system that has the potential to revolutionize the industry.

PlantArray Platform



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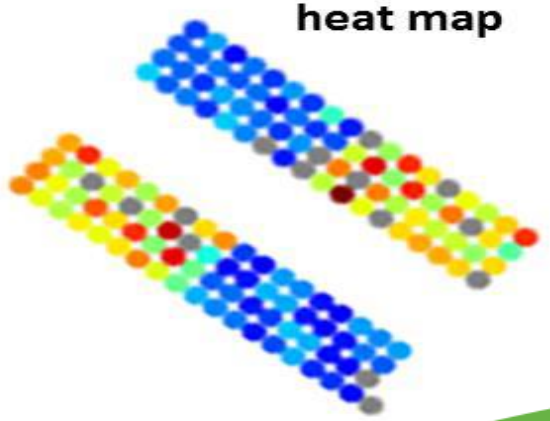
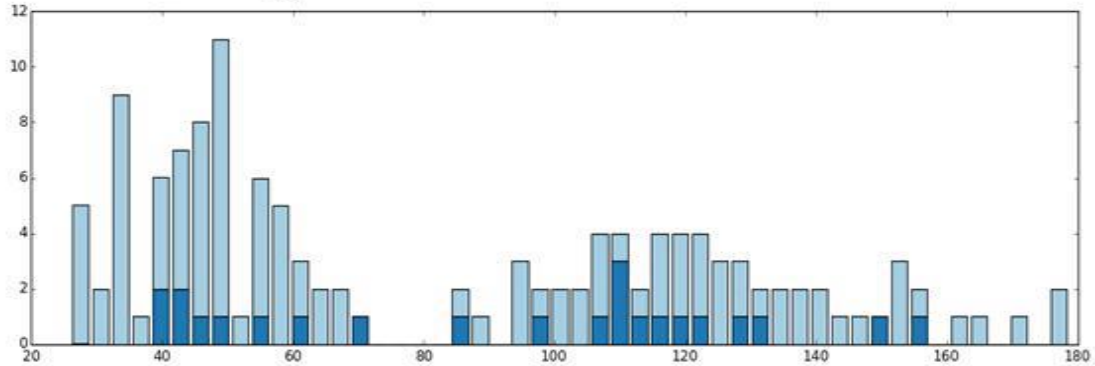
PlantArray System in action

Transpiration heat map



Well irrigation



Daily Transpiration distribution (ml/day)

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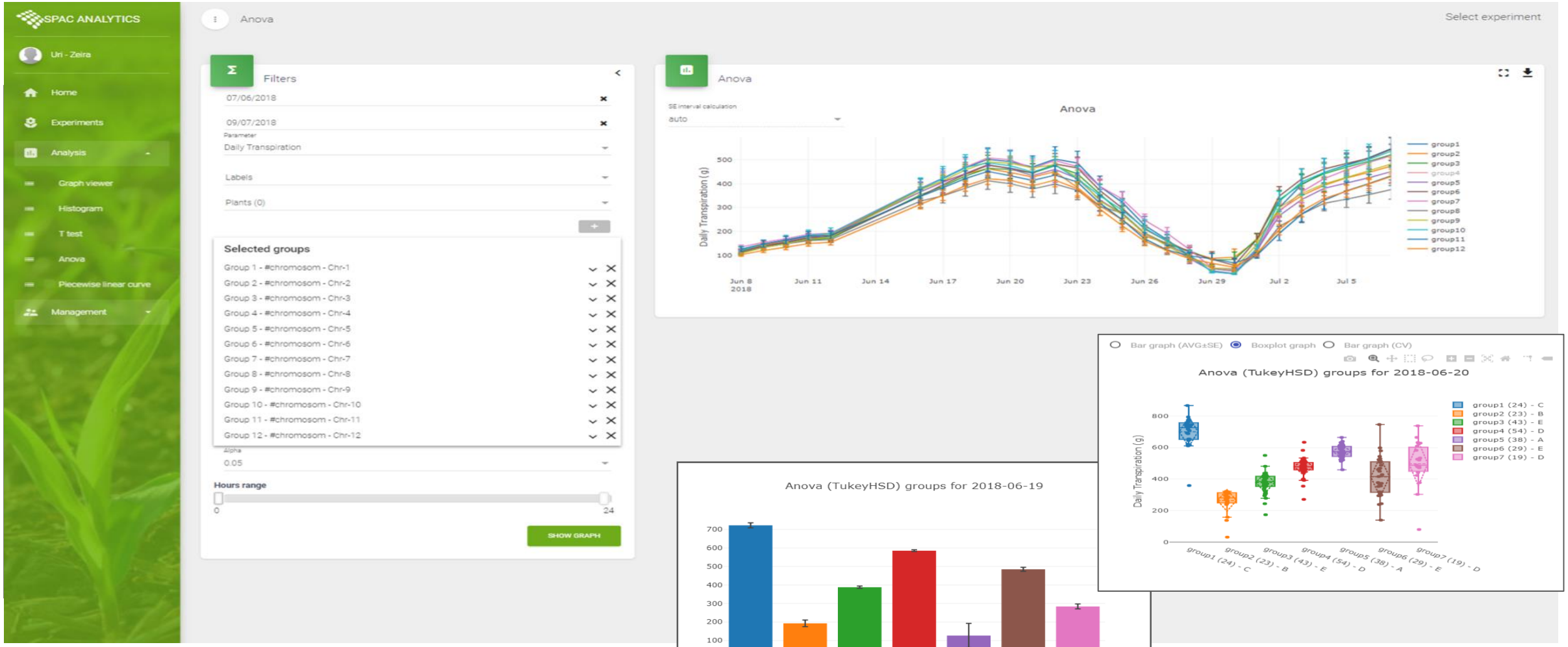
SPAC Analytics – real-time web software



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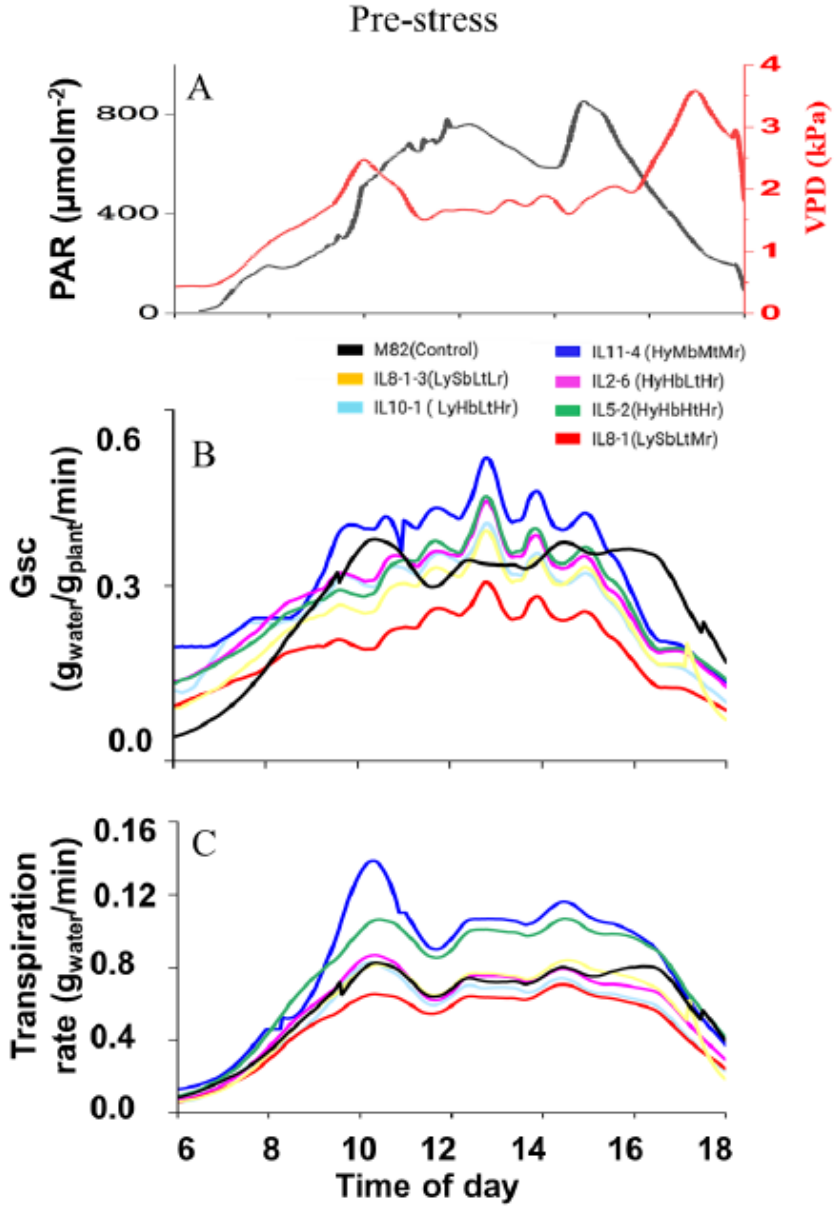
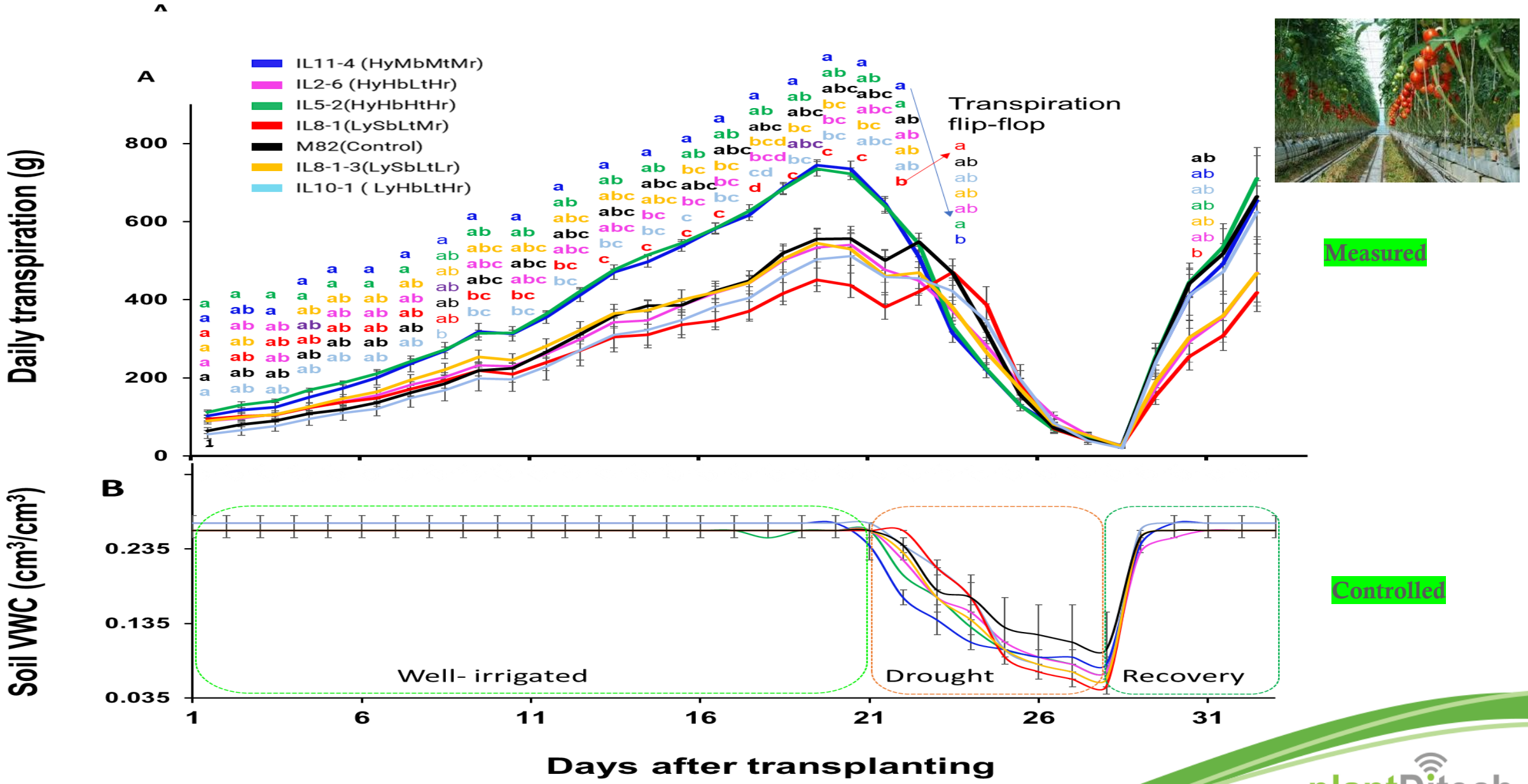
Dynamic plant response to the environment



Gosa et al., (2022) under revision, [also loaded to BioRxiv doi.org/10.1101/2022.01.06.475121]

Tomato varieties under drought & recovery - example



Measured

Controlled

Gosa et al., (2022) under revision, [also loaded to BioRxiv doi.org/10.1101/2022.01.06.475121]

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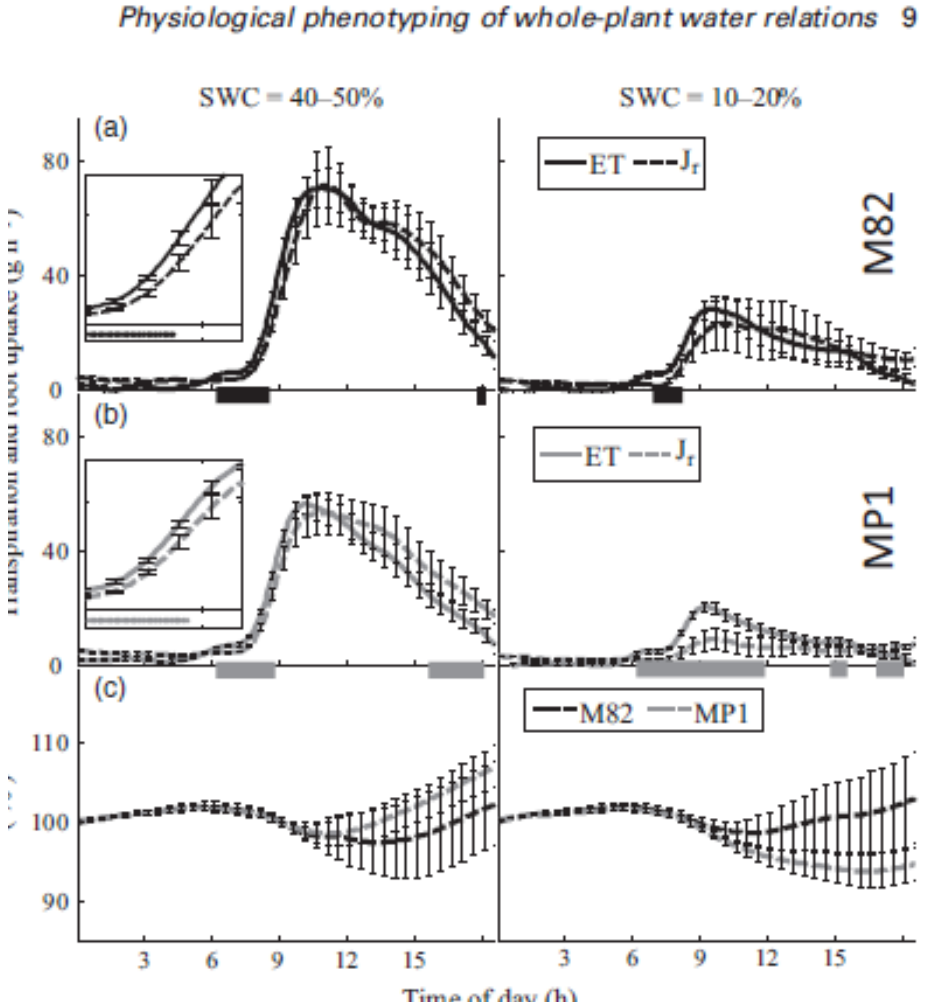
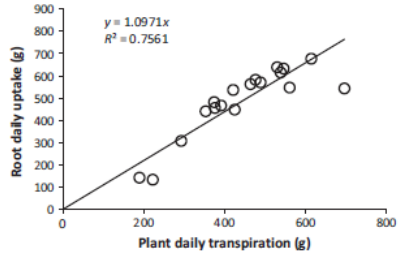
Continuous whole-plant transpiration (ET) and root uptake (Jr)





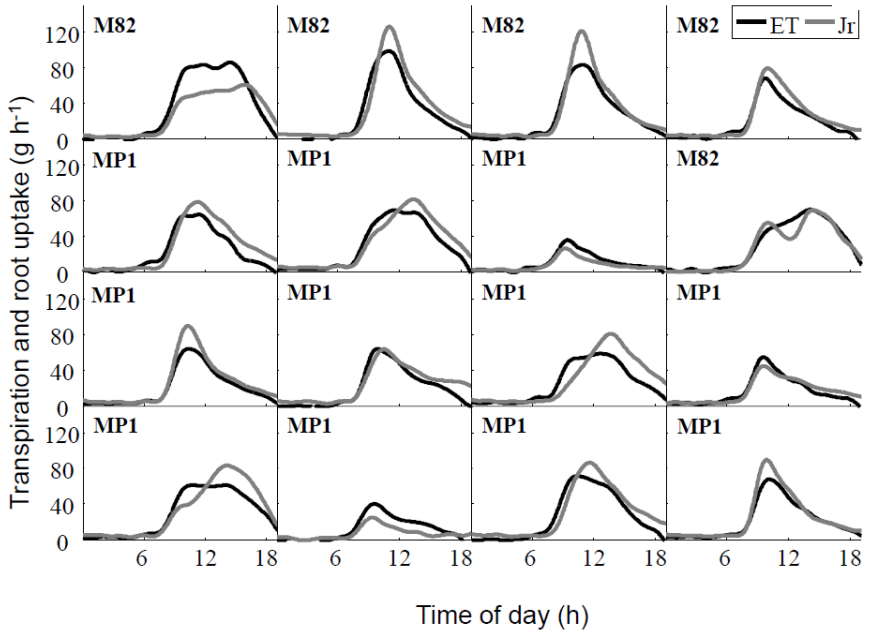


Figure S5. Continuous whole-plant transpiration (ET) and root uptake (J_r) for each individual plant over the course of day 7 (soil water content ~50%). Whole-plant relative water content was calculated for each plant separately based on the difference between the amount of water entering the plant and the amount of water leaving it.

frontiers in Plant Science

ORIGINAL RESEARCH
published: 05 August 2021
doi: 10.3389/fpls.2021.634311

High-Resolution Analysis of Growth and Transpiration of Quinoa Under Saline Conditions

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The Plantarray 3.0 phenotyping platform® was used to monitor the growth and water use of the quinoa varieties Pasto and selRiobamba under salinity (0–300 mM NaCl). Salinity reduced the cumulative transpiration of both varieties by 60% at 200 mM NaCl and by 75 and 82% at 300 mM NaCl for selRiobamba and Pasto, respectively. Stomatal conductance was reduced by salinity, but at 200 mM NaCl Pasto showed a lower reduction (15%) than selRiobamba (35%), along with decreased specific leaf area. Diurnal changes in water use parameters indicate that under salt stress, daily transpiration in quinoa is less responsive to changes in light irradiance, and stomatal conductance is modulated to maximize CO_2 uptake and minimize water loss following the changes in VPD (vapor pressure deficit). These changes might contribute to the enhanced water use efficiency of both varieties under salt stress. The mechanistic crop model LINTUL was used to integrate physiological responses into the radiation use efficiency of the plants (RUE), which was more reduced in Pasto than selRiobamba under salinity. By the end of the experiment (eleven weeks after sowing, six weeks after stress), the growth of Pasto was significantly lower than selRiobamba, fresh biomass was 50 and 35% reduced at 200 mM and 70 and 50% reduced at 300 mM NaCl for Pasto and selRiobamba, respectively. We argue that contrasting water management strategies can at least partly explain the differences in salt tolerance between Pasto and selRiobamba. Pasto adopted a "conservative-growth" strategy, saving water at the expense of growth, while selRiobamba used an "acquisitive-growth" strategy, maximizing growth in spite of the stress. The implementation of high-resolution phenotyping could help to dissect these complex growth traits that might be novel breeding targets for abiotic stress tolerance.

Keywords: quinoa, salt stress, Plantarray, transpiration, stomatal conductance, water use efficiency, radiation use efficiency, phenotyping

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Edited by:
John Doonan, Aberystwyth University, United Kingdom

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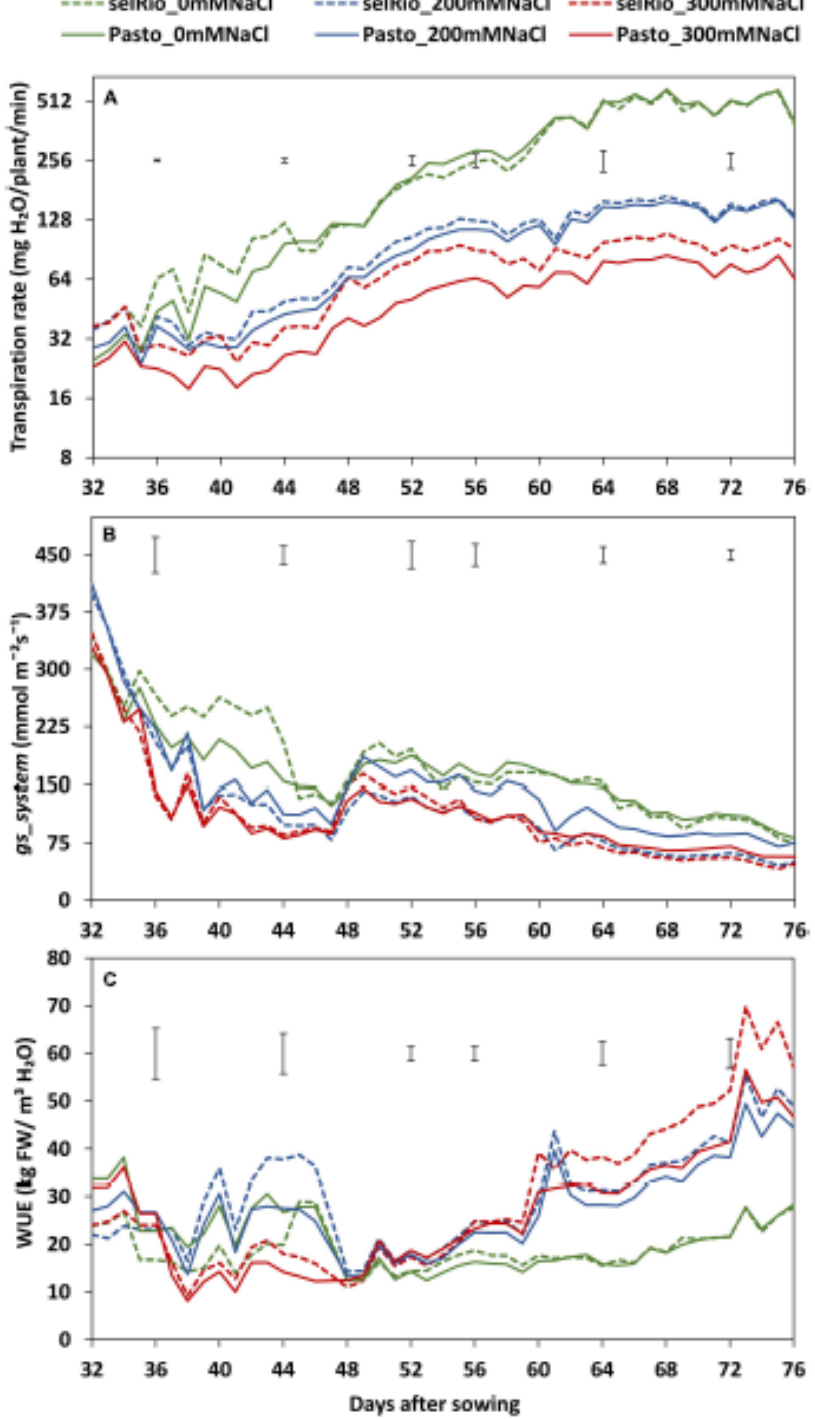
Specialty section:
This article was submitted to Technical Advances in Plant Science, a section of the journal Frontiers in Plant Science

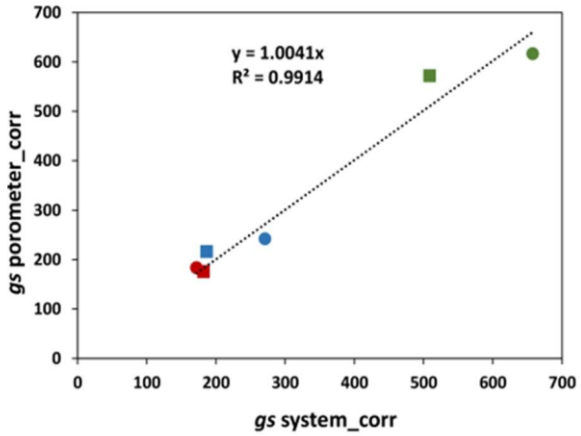
Received: *27 November 2020*
Accepted: *13 July 2021*
Published: *05 August 2021*

Citation:
Jaramillo Roman V, van de Zedde R, Peller J, Visser RGF, van der Linden CG and van Loo EN (2021) High-Resolution Analysis of Growth and Transpiration of Quinoa Under Saline Conditions.

INTRODUCTION

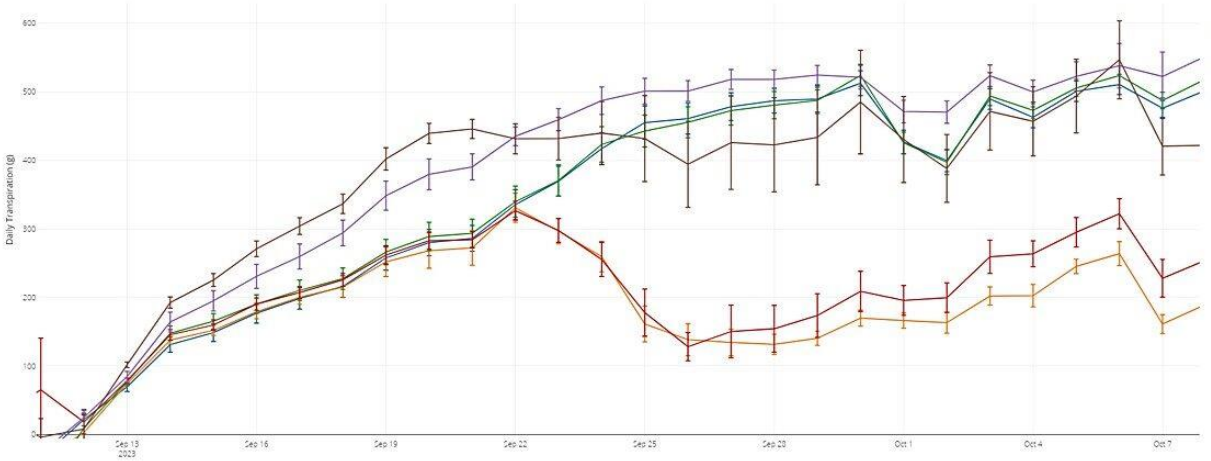
Plant breeding for abiotic stress tolerance has proven to be complex (Gilliham et al., 2017). A major challenge is that stress tolerance is a systemic process that involves a number of synchronized, interconnected physiological processes and genes operating together. A second





0.99 correlation to porometer stomatal conductance

New application: Flood control



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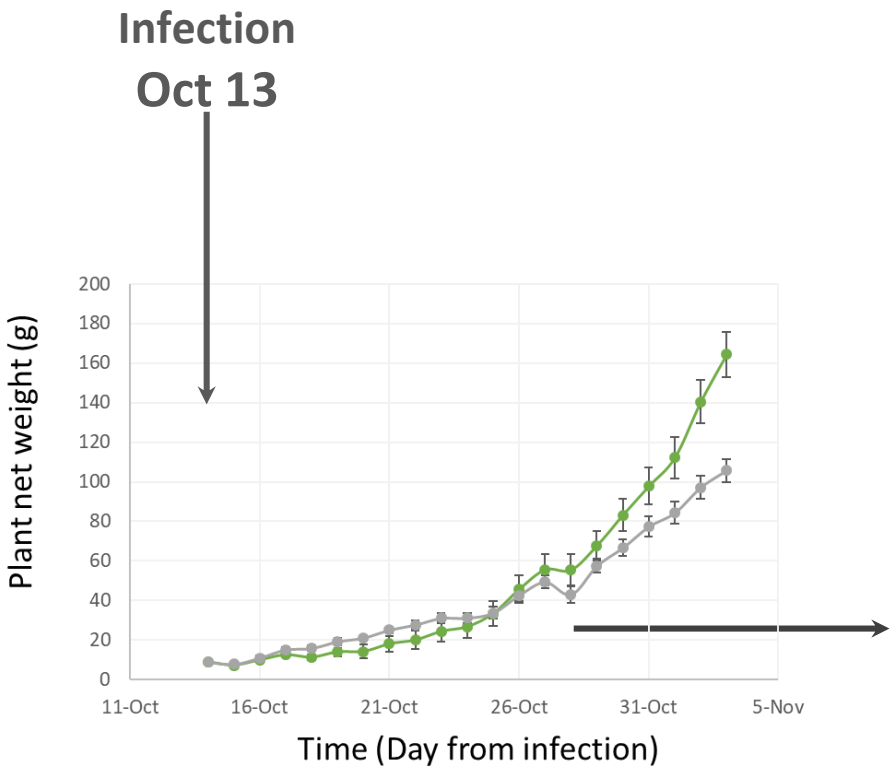
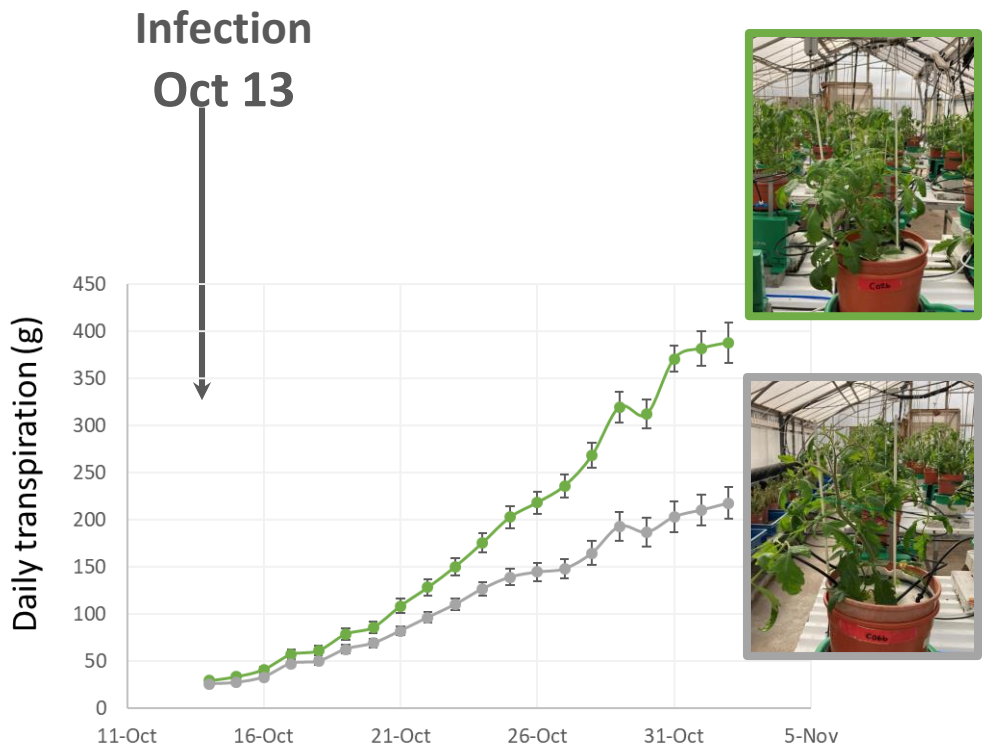
New application: Early detection of Diseases

M82

Fol-Violent





Fusarium

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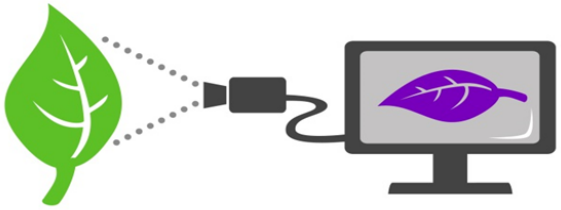
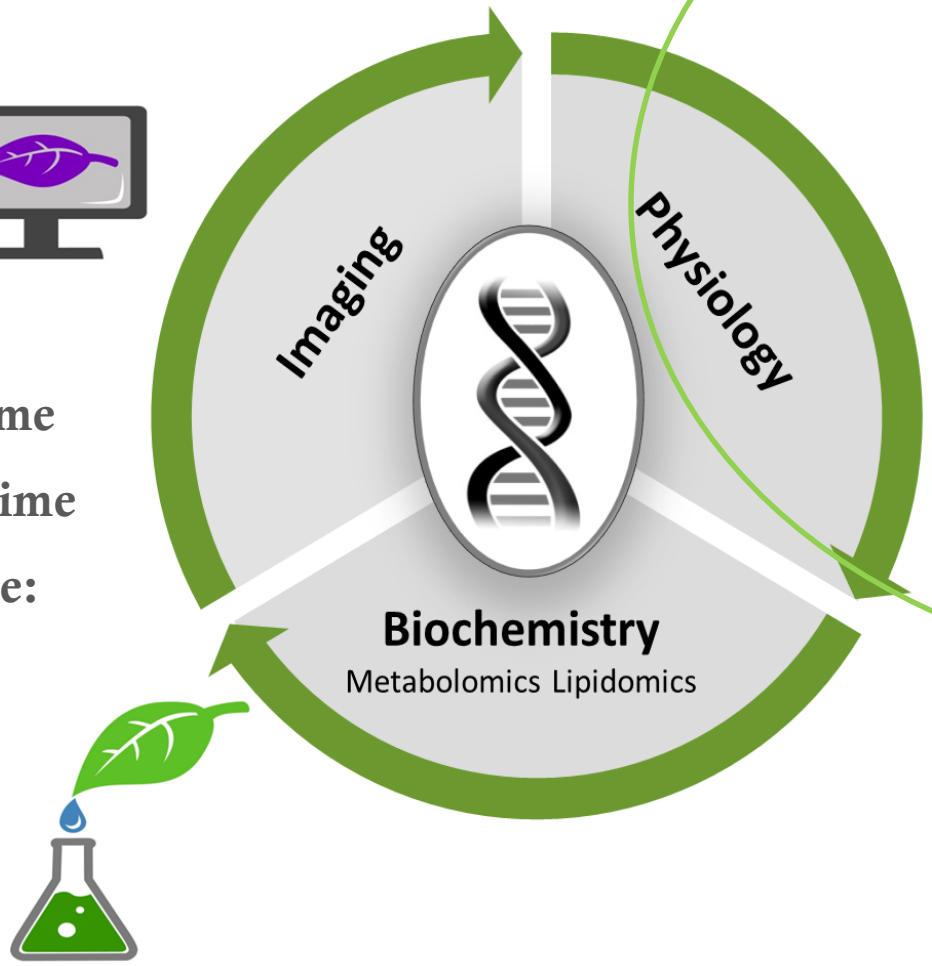
How do we differ?



- Structure, color
- Slow response time
- Few plants at a time
- Harder to analyze: cloud-points
- Little control



Distractive

PlantArray

- Function
- Simultaneous
- Continuous
- Immediate response and analysis
- Flexible control

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High spatial and temporal resolution

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